

## Description of the final stadium larva of *Philoganga vetusta* Ris, with discussion of the taxonomic characters of the larvae of the genus *Philoganga* Kirby (Odonata: Philogangidae)

Qi-han Xu\*

Department of Garden and Horticulture, Zhangzhou City University, Zhangzhou, Fujian, PR China

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The final stadium larva of *Philoganga vetusta* Ris is described and illustrated in detail. The larva of supposed *P. vetusta* from Hong Kong is confirmed, and that of *Philoganga* sp. from Fujian can be determined to be *P. robusta*. The taxonomic characters and systematic status of the larvae of genus *Philoganga* are discussed and summarized.

**Keywords:** Odonata; *Philoganga vetusta*; *Philoganga* Kirby; larva; taxonomic characters

### Introduction

The genus *Philoganga* Kirby includes four known species (Schorr & Paulson, 2015), occurring in Indo-China and Southeast Asia (Tsuda, 2000). To date, a larva of supposed *P. montana* (Hagen in Selys, 1859) from Assam of India has been illustrated and described by Fraser (1938), an immature larva of *Philoganga* sp. from Fujian of China has been illustrated and described by Chao (1948, 1953), two larvae of supposed *P. vetusta* from Hong Kong have been illustrated and described by Asahina (1967), and an early stadium larva of supposed *P. vetusta* from Hong Kong has also been illustrated and briefly described by Dudgeon (1999). During a visit to Fujian Agriculture and Forestry University last year, I found a pair of specimens of adult *P. vetusta* and their exuviae deposited in the specimen room of Institute of Biological Control Research. I borrowed them for study, and obtained a group of photographs of the reared larvae, which were photographed by my tutor. After careful study of the exuviae and the photographs of the reared larvae, and comparison with all published descriptions of *Philoganga* larvae, the final stadium larva of *P. vetusta* is described and illustrated in detail in the present paper, and the supposed larva of *P. vetusta* from Hong Kong is confirmed, the larva of *Philoganga* sp. from Fujian can be determined to be *P. robusta*. After analysis of the common morphological characters of the known *Philoganga* larvae, the taxonomic characters and systematic status of the larvae of the genus *Philoganga* Kirby are discussed and summarized here.

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\*Corresponding author. Email: [qihanxu@aliyun.com](mailto:qihanxu@aliyun.com)

**Description of the final stadium larva of *Philoganga vetusta* Ris, 1912*****Specimens studied***

Two exuviae: 1♂, 1♀, emerged in laboratory on 21 April 2008, the larvae were collected from Fuzhou National Forestry Park (26°05'N, 119°18'E) of Fujian by Jing-chang Chen and Zhi-peng Qiu on 22 March 2008; a group of photos of the reared larvae photographed by Chang-ming Liu.

***Description of the final stadium larva (Figures 1, 2)***

The larva with elongate body and large saccoid gills, predominantly brownish-black colored, except tarsus, claw and antenna, which are brown colored. General appearance and color pattern as shown in Figure 1.

**Head.** Roughly square, widest across eyes, which are comparatively large and slightly laterally protuberant. Frontal shelf well developed. Gena (Figure 2a), which is in front of eyes, furnished with a row of stout spines and rough setae on outer side, which are visible from dorsal side. Postocular lobe rounded, covered with numerous fine tubercles. Occipital margin arched inwards. Antenna (Figure 2b) 8-segmented, filiform, length ratio of segments as follows: 1: 2.36 : 1.86 : 1.47 : 1.17 : 0.81 : 0.42 : 0.28. Prementum (Figure 2c, d) broad and ovate, longer than wide, its distal half furnished with a row of serrations laterally; median lobe prominent anteriorly, with a open median cleft and clustered pale brown hairs on both extreme sides; premental setae absent. Palpal lobe about 3/5 the length of prementum, no setae present, its basal outer margin bearing many fine spines, and its apical portion deeply divided into three sharp, gently in-curved processes, the middle one longest, the uppermost one equal to the lowermost one in length; movable hook long and acuminate, curved inward. Mandible (Figure 2e-h) large, furnished with 6–7 robust serrations on outer surface.



Figure 1. Final stadium larva of *Philoganga vetusta* Ris, 1912: reared in container, dorsal view.

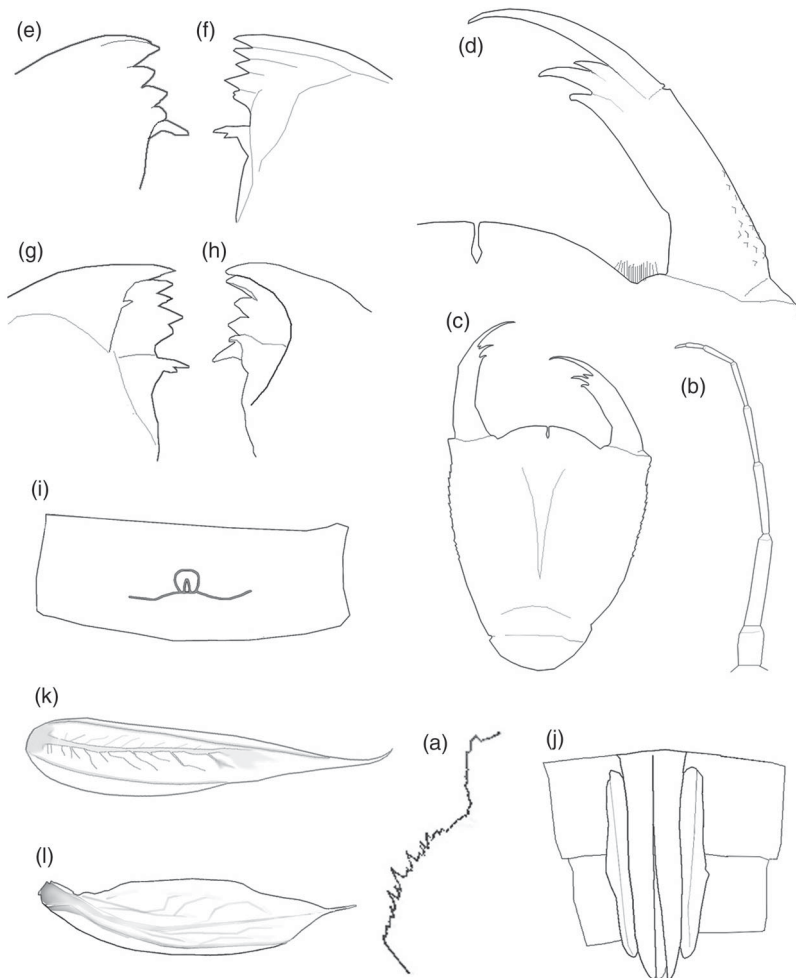


Figure 2. Morphological details of the final stadium larva of *Philoganga vetusta* Ris, 1912: (a) outer margin of gena, ventral view; (b) antenna, dorsal view; (c) prementum, ventral view; (d) palpal lobe and median lobe of prementum, ventral view; (e) left mandible, outer surface; (f) right mandible, outer surface; (g) right mandible, inner surface; (h) left mandible, inner surface; (i) male primary genitalia, ventral view; (j) female primary genitalia, ventral view; (k) lateral gill, dorsal view; (l) median gill (flattened), ventral view.

**Thorax.** Narrower than head. Pronotum trapezoidal; prothoracic pleura furnished with a row of small spines on outer side. Wing sheaths parallel along dorsum; hind-wing sheaths reaching beyond base of abdominal S7. Legs long; metafemur straight, reaching the base of abdominal S7; tarsal formula 3–3–3; claws small and simple.

**Abdomen.** Cylindrical, gradually narrowed to distal end. Vestigial male primary genitalia (Figure 2i) small, circle-shaped, situated on the middle of ventral S9. Female primary genitalia (Figure 2j) arising from the base of S9 and extending far beyond distal margin of S10. Caudal gills (Figures 1, 2k, l) fusiform and saccoid. Lateral gill curled downward, roughly three-surfaced, tapering backwards to a point; median gill resembles lateral gill, obviously triquetrous; when flattened in laboratory, median gill looks shorter and wider, and lateral gill longer and narrower.

**Measurements (mm).** Body length (including caudal gills) 40.0–41.1; maximum width of head 6.0–6.1; antenna 5.4–5.5; hind femur 9.8–10.0; hind-wing sheath 9.0–9.2; median gill 10.5–10.9; lateral gill 12.6–13.1;  $n = 2$ .

### Differential diagnosis

Asahina (1967) described the supposed *P. vetusta* larva, based on a final stadium one and an immature one, with three illustrations (head, prementum and lateral gill) and a photo of larval habitus. Then Dudgeon (1999) briefly described the supposed *P. vetusta* larva also, based on an immature one, with four illustrations (larval habitus, prementum, antenna and median gill). The larva of *P. vetusta* from Fujian does not differ obviously from those described by Asahina (1967) and Dudgeon (1999), so the supposed *P. vetusta* larva from Hong Kong could be confirmed now.

Chao (1948) reported a *Philoganga* larva under the name of *P. robusta* by supposition, based on the fact that the larva and the adult were collected at the same locality. Then he treated the larva as *Philoganga* sp. (Chao, 1953) because *P. vetusta* was found afterwards at the same locality also, and he was unsure of which *Philoganga* species the larva belonged to. Although the larva (Chao, 1953) was immature, and the three illustrations (larval habitus, prementum, and right mandible viewed from outer side) (Figure 3) were not enough to show all major larval characters, when compared with the final stadium and early stadium larvae of *P. vetusta*, it can be determined to be *P. robusta* now because it is easily separated from the larva of *P. vetusta* by the following characters (*P. vetusta* in parentheses): (1) wing sheaths strongly divergent (wing sheaths roughly parallel); (2) right mandible with the uppermost serration longest, and the lowermost one not forked (right mandible with the uppermost serration not longest, and the lowermost one forked); and (3) anterior border of prementum trapezoid-shaped (anterior border of prementum arch-shaped).

The larva of *P. vetusta* can be distinguished from that of *P. montana* by the following characters (*P. montana* in parentheses): (1) wing sheaths parallel along dorsum (wing sheaths divergent); (2) abdomen entirely brownish-black (some pale yellow markings on the distal five segments of abdomen in the form of sagittate middorsal basal spots and moderately broad lateral stripes); and (3) caudal gills fusiform and saccoid, not divided into two parts (caudal gills saccoid in proximal two thirds, broadly spatulate and acuminate for the distal third).

### Discussion of the taxonomic characters and systematic status of the larvae of the genus *Philoganga* Kirby

After analysis of the common morphological characters of the known *Philoganga* larvae (*P. montana*, *P. robusta* and *P. vetusta*), the major taxonomic characters of the larvae of the genus can be tentatively summarized as follows: (1) head roughly square-shaped; (2) anterior basal margin of eye bordered by a variable number of stout spines and rough setae; (3) antenna 8-segmented, filiform; (4) prementum furnished with a row of serrations laterally; median lobe prominent, with a medial cleft; apical portion of palpal lobe deeply divided into three processes, the middle one longest; movable hook long and acuminate; (5) caudal gills sacciform or triquetrous, tapering backwards to a point.

The systematic position of *Philoganga* remained problematic for a long time. Fraser (1938) remarked that the discovery of the larva of *P. montana*, which closely resembles that of *Diphlebia*, no longer leaves doubt as to its correct place in the family Amphipterygidae, which includes both *Philoganga* and *Diphlebia* in Davies and Tobin's taxonomic system (1984). The larvae of *Philoganga* and *Diphlebia* indeed share some common characters, such as (1) palpal lobes of prementum have three processes and one movable hook; (2) anterior basal margin of eye bordered by a variable number of stout spines and rough setae; and (3) caudal gills long and of saccoid type, etc. but they have their own characters respectively and can be separated from each other.

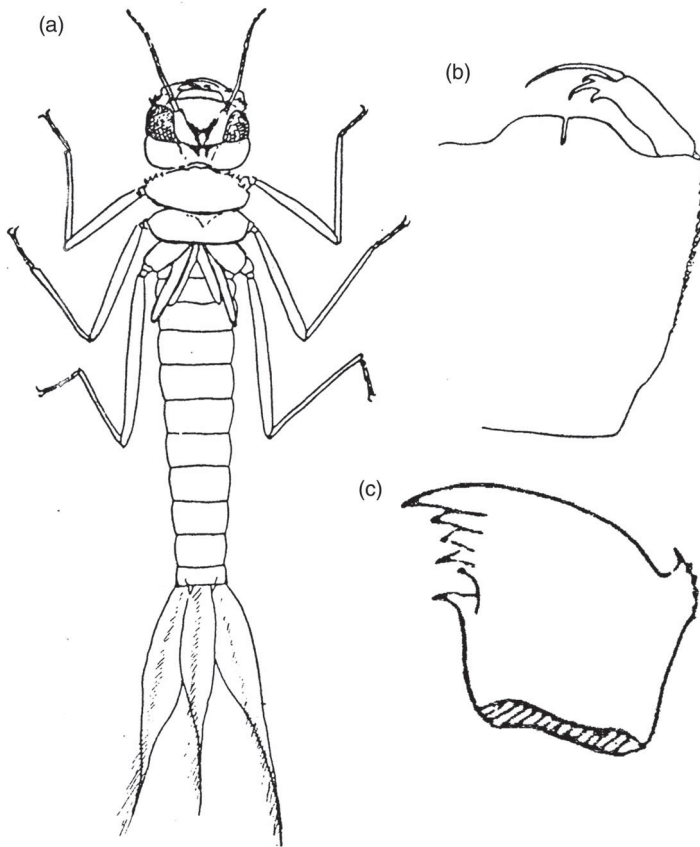


Figure 3. Immature larva of *Philoganga robusta* (cited from Chao, 1948): (a) larval habitus; (b) prementum; (c) right mandible, outer side.

The recent work of Dijkstra, Kalkman, Dow, Stokvis, and van Tol (2013) suggested that *Philoganga* and *Diphlebia* are not close relatives, and they belong to different families. *Philoganga* larvae can be separated from *Diphlebia* larvae, which were described and illustrated in detail by Stewart (1980) and Theischinger (2009), by the following characters (the latter in parentheses): (1) antenna 8-segmented (antenna 7-segmented); (2) median cleft in median lobe of prementum open (median cleft in median lobe of prementum closed); (3) outer margin of palpal lobe with row of fine spines (outer margin of palpal lobe with row of short and stout setae); (4) inner process of palpal lobe sharp at tip, equal to uppermost one in length (the inner one is shortest and more or less truncate at tip); and (5) propleuron of prothorax without any projections (propleuron of prothorax forms double pointed projecting shelf of unequal lengths).

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